

ionization chamber. The high voltage acceleration stage is now defined as serving to accelerate said ions towards a target and the occluded reaction target has been defined as producing neutrons upon impact by said ions. As will be discussed in greater detail hereinafter, it is respectfully submitted that the cited prior art, either applied alone or in combination, does not disclose or suggest a neutron generator as presently claimed.

With respect to the rejection of claims 1-4, 7 and 10 as being anticipated by either Reifenschweiler or Chen et al., Applicant respectfully submits that these references simply represent the state of the art to which Applicant has addressed himself. In particular, Applicant recognizes that the basis for almost all neutron generators manufactured today are from the pioneering work of Reifenschweiler and his co-workers in the 1950's. Nevertheless, there are significant distinctions between the basic design and that of the present invention which was specifically developed to provide a neutron generator capable of treating cancerous tumors by brachytherapy. Attached hereto is a chart which sets forth the differences between the Reifenschweiler reference and the present invention. As noted in the first two criteria, Reifenschweiler employs a Penning discharge for neutron generation wherein the ionization mechanism is an arc discharge of gas. In contrast thereto, the present invention provides for electron bombardment wherein the ionization mechanism involves an electron beam which generates ions by collision with a gas. Similarly,

Chen doesn't produce a beam, but rather simply heats a cathode to deliver electrons which are not focused into a beam.

As specifically applied to tumor treatment by brachytherapy (source in contact with the tumor), the neutron generator head must be equipped with a needle with a targeted end that is affixed to the body. The needle for most tumor treatment applications must be 3 mm in diameter, or so, or at least 10 mm long such that it can penetrate the body and reach the tumor. To be affixed to the body, the neutron generator head must weigh a kilogram or less. Moreover, the power dissipated in the system must be so low that no harm comes to the patient from heat (e.g., as set forth claim 3, the generator operates at a low 25 watts).

Moreover, it should be noted that Reifenschweiler described the half angle of angular divergence of the beam in an optimized configuration to be 0.1 radians (pg. 69, first paragraph under heading "Accelerating System"). For a needle configuration, with 3 mm diameter, and the focal point half way down the needle, the Reifenschweiler divergence limits the needle length to 3 cm. The design of the present invention has proven capable of transmission of a 3 mm beam over 15 cm. This is explained by the high quality beam of the electron bombardment source. To Applicant's knowledge, there is no teaching that a Penning discharge source can be used to transmit a 3 mm beam required by brachytherapy over a 10cm needle (note claim 9), as presently claimed.

Similarly, the rejection of claims 5,6,8, and 9 as being unpatentable over Reifenschweiler in further view of Chen et al. is respectfully traversed. Here too, neither of the cited references disclose or suggest a neutron generator having an electron bombardment ion source for generating ions via collision of an electronic beam with a gas which has an ion extraction slit and focusing apertures each being equal to or greater than 3 mm.

With respect to the 112 rejection of claim 9, as a result of the amendment to claim 1, there is now proper antecedent basis for the limitation "exit slit" in line 2 of this claim.

Concerning finally the 112 rejection of the claims as being based upon an inadequate disclosure for the reason set forth in paragraph 2 of the Office Action, it should be noted that the results identified in the last paragraph on page 14, first paragraph of page 15 are derived from the results as illustrated in the Figures.

With respect to the Examiner's objection to the beam being steered by rasterizing in that the exact components thereof are not described in detail, the steering step as described in the specification would be understood by those skilled in the art without requiring undue experimentation. In particular, the specification at the bottom of page 12, last sentence specifically describes the steering of the beam as being accomplished by rasterizing the beam as with a CRT display. The

specification at page 12, lines 13-15 also refers to the use of focus plates 26 for accelerating and focusing the ions toward the ion exit 28 and as being separately controllable for steering the ion stream; see also pg. 8, lines 3-6 and lines 14-19 pg. 16, lines 9-12 which also refers to the use of low voltage source steering plates. In light thereof it is believed that claims 1-10 and specifically claims 3, 5, 6, and 8 are supported by an adequate and enabling disclosure.

In view of the foregoing, reconsideration and withdrawal of the rejection and allowance of the claims at an early date are earnestly solicited.

Respectfully submitted,



Thomas M. Galgano, (27,638)
GALGANO & BURKE
Attorneys for Applicant
300 Rabro Drive, Suite 135
Hauppauge, NY 11788
(631) 582-6161

TMG/jgg

Enclosures: 1) pgs. 7 and 8 Version Of Markings To Show Changes
2) One Page Comparison Chart

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I hereby certify that this correspondence is being deposited with the United States Postal Service as first-class mail in an envelope addressed to: Commissioner of Patent and Trademarks, Washington, D.C. 20231 on March 5, 2003.

By: 
Thomas M. Galgano, Esq.

Dated: March 5, 2003

VERSION WITH MARKINGS TO SHOW CHANGES MADE

IN THE CLAIMS

Please rewrite claim 1 as follows:

1. (Amended) A neutron generator, comprising:

a) an electron bombardment ion source having a gas-fillable ionization chamber, an ion exit slit and focusing apertures each being equal to or greater than 3 mm, said ion source having means for generating an electronic beam which creates ions by collision with a gas in said ionization chamber;

b) a high voltage acceleration stage for accelerating said ions towards a target; and

c) an occluded reaction target [wherein said neutron generator has an ion extraction slit and focusing apertures each being equal to or greater than 3mm] which, upon impact by said ions, produces neutrons.

DIFFERENCES BETWEEN REIFENSCHWEILER AND PRESENT INVENTION

Source Type	Penning discharge	Electron bombardment
Ionization mechanism	Arc discharge of gas	Electron beam collisions with gas
Source of electrons	Electrons in a field are accelerated To cause ionization hence more Electrons until loss mechanisms Balance further electron production.	Filament provides electrons that are accelerated toward a defining slit, and focused by a cylindrical grid.
Energy of electrons	Varies within the ionization volume	Fixed by the electron gun power supply, hence may be Optimized for ion production of a chosen species.
Volume of ionization region	Electrons oscillate between cathodes and spiral along magnetic field lines in a volume of the order of 1 cm in radius by 2 cm long, or a Volume of about 6 cm ³ .	Ions are produced by an electron beam 2mm in radius in an active length of 1 cm ³ in a volume of about 0.1 cm ³ .
Ion production rate	Varies with gas pressure	Varies with gas pressure
Power for ion production	Varies with gas pressure	Fixed as sum of filament and electron gun power
Ion extraction	Ions are accelerated toward The extraction orifice by cathode's Relative potential.	Ions are accelerated by the electric field lines penetrating an extraction slit as aided by a repeller that "pushes" ions Toward the extraction slit.